



**BACKGROUND GROUNDWATER  
QUALITY STUDY  
TUOLUMNE UTILITIES DISTRICT  
WASTEWATER RECLAMATION SYSTEM  
ROSASCO AND GARDELLA PROPERTIES  
(WDR No. R5-2002-0202)  
TUOLUMNE COUNTY, CALIFORNIA**

**January 30, 2009**

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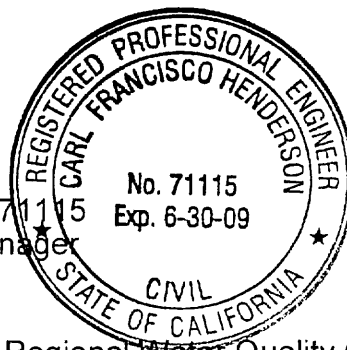
**Background Groundwater Quality Study  
Tuolumne Utilities District  
Wastewater Reclamation System  
Rosasco and Gardella Properties  
(WDR No. R5-2002-0202)  
Tuolumne County, California**

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## TABLE OF CONTENTS

CHAPTER		PAGE
<b>EXECUTIVE SUMMARY .....</b>		<b>1</b>
<b>1 SITE SETTING .....</b>		<b>4</b>
1.1. SITE LOCATION .....		4
1.2. CURRENT USE AND SITE CHARACTERISTICS .....		4
1.3. REGIONAL GEOLOGY AND HYDROGEOLOGY .....		5
<b>2 BACKGROUND.....</b>		<b>7</b>
2.1. MONITORING WELL INSTALLATION .....		8
2.2. INTERIM GROUNDWATER LIMITATIONS.....		11
<b>3 GROUNDWATER MONITORING DATA .....</b>		<b>13</b>
3.1. GROUNDWATER ELEVATIONS AND GRADIENTS .....		13
3.2. GROUNDWATER QUALITY .....		14
3.3. EFFLUENT QUALITY .....		16
<b>4 BACKGROUND GROUNDWATER QUALITY ASSESSMENT METHODOLOGY.....</b>		<b>18</b>
4.1. EVALUATION OF BACKGROUND WATER QUALITY .....		18
4.2. BACKGROUND WATER QUALITY VS. ON-SITE WATER QUALITY.....		20
4.3. BACKGROUND AND ON-SITE GROUNDWATER QUALITY VS. INTERIM GROUNDWATER LIMITATIONS .....		22
<b>5 DISCUSSION OF FINDINGS AND RECOMMENDATIONS.....</b>		<b>23</b>
5.1. DISCUSSION OF FINDINGS .....		23
5.2. RECOMMENDATIONS.....		26
<b>6 LIMITATIONS .....</b>		<b>29</b>
 <b>TEXT TABLES</b>		
1	Monitoring Well Locations .....	9
2	Monitoring Well Construction Detail.....	10
3	Monitoring Well Constructed Elevations .....	11
4	Interim Groundwater Limitations .....	12
5	Groundwater Analytical Results (Rosasco).....	15
6	Groundwater Analytical Results (Gardella) .....	16
7	Effluent Analytical Results (Quartz Reservoir) .....	17
8	Averaged Background Subsurface Water Concentrations .....	20
9	Background Water Concentrations vs. On-Site Water Quality.....	21
10	Background and On-Site Water Concentrations vs. Interim Water Limitations .....	22
11	Recommended Groundwater Limitations.....	27
 <b>TABLES</b>		
1	Depth to Groundwater and Groundwater Elevation	
2	Concentrations of Analytes in Groundwater, Rosasco and Gardella Sites	
3	Concentrations of Analytes in Groundwater, Quartz Reservoir	

## PLATES

- 1 Site Vicinity Map
- 2A Monitoring Well Location Map, Rosasco Property
- 2B Monitoring Well Location Map, Gardella Property
- 3A Groundwater Elevation Map, Rosasco Property (October 30, 2007)
- 3B Groundwater Elevation Map, Rosasco Property (March 18, 2008)
- 3C Groundwater Elevation Map, Rosasco Property (June 24, 2008)
- 3D Groundwater Elevation Map, Rosasco Property (September 22, 2008)
- 3E Groundwater Elevation Map, Gardella Property (November 8, 2007)
- 3F Groundwater Elevation Map, Gardella Property (March 18, 2008)
- 3G Groundwater Elevation Map, Gardella Property (June 24, 2008)
- 3H Groundwater Elevation Map, Gardella Property (September 22, 2008)

## Appendix A – Quartz Reservoir Effluent Laboratory Data

## EXECUTIVE SUMMARY

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Kleinfelder has completed four consecutive quarterly subsurface monitoring events conducted between the fourth quarter 2007 and the third quarter 2008 and prepared this Background Quality Study for Tuolumne Utilities District (TUD). The activities were conducted in accordance with Kleinfelder's workplan dated April 6, 2006.

The goal of this study is to evaluate and compare background water quality to water quality downgradient of wastewater ponds and application fields on two relatively larger application sites within the TUD system. This study incorporates effluent water quality data from the Quartz Reservoir. The TUD monitoring well network includes 16 monitoring wells located near the main storage reservoir (Quartz Reservoir) and the Rosasco and Gardella application properties.

The background water quality was estimated using the historical data collected from all of the compliance monitoring points over four consecutive quarters (October 2007 to September 2008) in accordance with Title 27 CCR Section 20415 (e)(10). The monitoring points located farthest upslope in each of the application fields and storage ponds (where applicable) were used to assess the background subsurface water quality since shallow subsurface water flow generally mimics surface topography. Each application field displays a relatively uniform slope. The Rosasco site slopes toward the south/southeast, and the Gardella site slopes toward the southwest.

The water quality for each background monitoring point was evaluated by averaging the concentrations over the assessment period. The average analyte concentrations from upslope wells at the Rosasco and Gardella sites were used to establish general background concentrations for the shallow subsurface water at both sites.

In general, the background subsurface water quality was poorer than the secondary treated wastewater effluent quality. Only iron was higher in concentration in the effluent versus the average background quality.

At the Rosasco site, the concentrations of chloride, total dissolved solids (TDS), and nitrate as N from downgradient wells (M-10 and M-11) were higher than the average background concentrations, whereas iron, manganese, sodium, total kjeldahl nitrogen (TKN), and pH were lower than the average background concentrations. The concentrations of iron, manganese, sodium, TKN, and pH appear to decrease with distance from the initial upslope flood application area.

At the Gardella site, the reported downgradient concentrations to the storage pond (M-13 and M-14) showed that concentrations of boron, chloride, sodium, TDS, nitrate as N, and pH were higher than background concentrations, and iron, manganese, and TKN analyte concentrations appear to decrease with distance from the initial upslope application point. With the exception of iron, each of the requested analytes from downgradient wells M-15 and M-16 (Gardella application field) were found to be below averaged background values.

The estimated background groundwater quality for chloride, iron, manganese, sodium, coliform, and TDS exceeded the interim groundwater limitations. The averaged concentrations of chloride, iron, manganese, sodium, coliform, and TDS in all of the downgradient wells on the Gardella site, and only chloride, sodium, coliform, and TDS on the Rosasco site, exceeded the average background groundwater quality and interim groundwater limitations. It should be noted that the two downgradient wells located directly adjacent to the Gardella Storage Pond (M-13 and M-14) have little or no vegetation nearby for the uptake of nutrients and may account for the elevated concentrations above background for sodium, chloride, and TDS compared to the furthest downgradient wells located southwest of the application field (M-15 and M-16). It appears that the uptake of nutrients across the application field is sufficient for most nutrients as the concentration of sodium, chloride, and TDS decrease with distance to concentrations below background.

The overall groundwater quality beneath the Rosasco site appears to be of a better quality than the groundwater beneath the Gardella site, for both the upgradient and downgradient monitoring points. This may be a function of the total thickness of the soil profile in which the monitoring wells are installed. The soil profile appeared to be generally thicker on the Rosasco site versus the Gardella site and thus may offer a

thicker soil profile for applied water to percolate through. Crops are actively grown on the Rosasco site which would typically uptake more nutrients in contrast to the Gardella site which is primarily used for cattle grazing. A vast area of the northern portion of the Gardella site is depicted as having dredge tailings present and extending northward and off-site which might account for concentrated constituents such as iron and manganese, and for rapid groundwater movement which would inhibit nutrient uptake.

Based on the results of this study and in accordance with the WDR, where the estimated background concentrations are greater than the interim limitations, we have recommended alternative limitations (increases) for iron, manganese, and total dissolved solids to reflect the average background quality.

This report is subject to the limitations presented in Chapter 6. Any other party (other than TUD or regulatory agencies having enforcement jurisdiction for the site) who would like to use this document shall notify Kleinfelder, Inc. of such intended use in writing requesting permission to do so.



## 1 SITE SETTING

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### 1.1. SITE LOCATION

The TUD reclamation system is located in the foothills along State Highway 108 extending southeast from Sonora to southeast of Jamestown (Plate 1). The System encompasses the distribution of reclaimed water along nine miles of 6 to 24-inch pipelines to 27 end user sites (56 individual parcels) across a total land application area of approximately 630-acres. The Rosasco and Gardella Properties represent the largest of the multiple end user sites and are located southeast of Jamestown. The largest of the Rosasco land application areas is parcel 58-180-20 (approximately 103 acres) located adjacent north of Highway 108 (Plate 2A). The largest of the Gardella land application areas includes parcels 58-230-18/76 (approximately 107 acres), located east of Montezuma Road (Plate 2B). The over-all site area is located within the U.S. Geologic Survey, Sonora 7.5 Minute Series Topographic Map. The Rosasco property is located in Sections 20 and 29, and the Gardella property in Section 33, T1N, R14E of the Mount Diablo Baseline and Meridian (MDB&M).

### 1.2. CURRENT USE AND SITE CHARACTERISTICS

The Rosasco and Gardella sites represent the largest land application end user sites of the TUD Wastewater Reclamation System. These two properties were selected to be monitored on the basis they will generally represent potential reclaimed water impact to subsurface water quality for the entire System. The reclaimed water is used to irrigate cattle grazing land on both the Rosascos and Gardellas properties.

The largest of the Rosasco properties receiving reclaimed water includes topography that slopes gently towards the south/southeast. Water storage ponds are located in the northeastern and northwestern areas of the parcel and a tailwater return pond is located in the southeastern corner of the parcel. All of the ponds are unlined. A small residential area is located adjacent to the southwestern corner of the parcel. The planted and managed pastures encompassing most of the parcel are flood irrigated with reclaimed

water. Elevations at the Rosasco Property range from approximately 1300 to 1400 feet above mean sea level (msl).

The largest of the Gardella properties receiving reclaimed water includes areas sloping gently towards the southwest. An unlined water storage pond is located along the northeastern edge of the application areas. A tailwater return pond is located in the southeastern corner of the parcels. A spring and intermittent stream are located near the western border of the application area. Mine tailings are depicted on the topographic map along the eastern portion of the Gardella property. The parcels appear to be used primarily for cattle pasture and are irrigated with a sprinkler system. Elevations at the Gardella parcels range from approximately 1,200 to 1,300 feet above msl.

### **1.3. REGIONAL GEOLOGY AND HYDROGEOLOGY**

The TUD Wastewater Reclamation System is located in the western foothills of the Sierra Nevada Geomorphic Province of California. The rocks of the Sierra Nevada Province include both subjacent and superjacent series rocks. Subjacent rocks include metasedimentary rocks intruded by the Sierra Nevada batholith. The major plutons include quartz, diorite, and granite. The superjacent series includes marine sediments, more recent gravels and conglomerates, and Tertiary volcanics. The geology along the western foothills of the Sierra Nevada, in the vicinity of the site, is characterized by a belt of strongly deformed but weakly metamorphosed rocks of the subjacent series and river gravels and volcanic deposits of the superjacent series.

Kleinfelder reviewed the subject site on the California Division of Mines and Geology (CDMG) "Geologic Map of the San Francisco-San Jose Quadrangle" (Wagner, Bortugno, and McJunkin, 1991). The CDMG 1:250,000 scale map is a "regional map" with an approximate scale of 1 inch = 21,000 feet, and therefore, interpretation from this map is subject to some error. This map indicates that the geologic units underlying the Rosasco property include the Tertiary Mehrten Formation and the Jurassic Mariposa Formation. Geologic units depicted underlying the Gardella property include, in order of abundance, Tertiary gravels, the Mariposa Formation and Quaternary tailings. The Mehrten Formation is composed of andesitic and basaltic agglomerate, tuff, breccia, volcanic conglomerate, tuffaceous sandstone, siltstone and clay. Rocks of the Mariposa Formation include slate, sandstone, siltstone, tuff, greywacke, and fine-grained

conglomerate. Tertiary gravel includes river gravel and sand of pre-Tertiary age and is described as frequently containing aquifers. Quaternary tailings include gravel and sand deposited as a result of historical mining operations.

The site lies between the Melones and Bear Mountain Fault Zones which together comprise part of the Foothill Fault System, the main structural feature in the region. The principle traces of the Melones Fault Zone are located approximately 2.5 miles east of the site. What appears to be a splay of the Melones Fault Zone is depicted in the vicinity of the northeastern portion of the Rosasco property.

Generally, groundwater in the area for domestic or agricultural water wells is found at a depth of 100 feet or greater. First encountered subsurface water, based on field data gathered during monitoring well installation, occurred at the interface of the soils overlying bedrock in fractured rock and potential perched zones, at depths of approximately 13 feet to 24 feet below ground surface (bgs). The first encountered water is expected to occur at shallower depths during the rainy season and at lower depths during the dry season.

Kleinfelder anticipates that shallow subsurface and seasonal perched water will likely mimic the surface topography and collect at the base of surficial colluvium and more dense sediments and bedrock. Groundwater is expected to generally flow south/southeast on the Rosasco property and southwest on the Gardella property. Shallow subsurface water was found in topographically low areas and near natural drainages, where thicker units of sediment and colluvium would be expected.

## 2 BACKGROUND

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TUD operates a reclaimed water distribution system, which consists of the main storage reservoir (Quartz Reservoir), pumping facilities, distribution pipelines, and smaller storage ponds which are used to hold the secondary treated and disinfected reclaimed water. The reclaimed water is dispersed to land application areas via flood and spray irrigation practices. The treated water originates from the Sonora Regional Wastewater Treatment Plant (WWTP) and the Jamestown Sanitation District's WWTP and flows by gravity to Quartz Reservoir. The Quartz Reservoir capacity is approximately 1,500 acre-feet. The reclaimed water is delivered to end-user land application areas along nine miles of pipelines and through 18 turnouts. The total acreage of the land application areas is approximately 630 acres. There are five monitoring wells (M-1 through M-5 ) located around Quartz Reservoir which are being monitored and reported separately by TUD.

The RWQCB required TUD to submit a workplan for the characterization of the groundwater quality near Quartz Reservoir (reservoir which holds the application field water prior to distribution), sensitive end-user storage ponds, and the most sensitive land application areas which display the most potential to impact subsurface shallow water. Additionally, TUD is required to conduct quarterly groundwater monitoring, provide quarterly reports detailing the results, and submit a background groundwater quality study report following at least four consecutive quarterly monitoring events. These activities have been requested by the RWQCB for compliance with the groundwater monitoring portion of the Waste Discharge Requirements/Master Reclamation Permit Order No. R5-2002-0202 (WDRs).

A fracture trace analysis was performed in order to provide rationale for the placement of monitoring wells in either shallow subsurface water zones or deep groundwater zones. Kleinfelder reviewed site specific data for the Rosasco and Gardella properties as having the most potential to impact groundwater and generally be representative of the project land application areas. Kleinfelder assessed the potential for fractures in bedrock beneath the Rosasco and Gardella properties using aerial photographs and published

geological data of the sites. A geophysical survey consisting of a near-surface conductivity survey (which measures the conductivity of the soil profile and typically suggests a thicker or thinner soil profile in reference to a higher or lower conductivity value, respectively) was performed on the Rosasco property. The geophysical survey coincided with field reconnaissance conducted by Kleinfelder geologists.

The results of the geophysical survey showed the majority of the Rosasco irrigated fields to be overlain by relatively thin soil layer. There were some areas of relatively higher conductivity values (interpreted as areas of thicker soil). While limited in the area assessed, there was no evidence of fractures on the land application area of the Rosasco property during the conductivity survey or field reconnaissance. Based on the results of the fracture trace assessment, Kleinfelder submitted a workplan titled "Workplan, Groundwater Monitoring Well Installation, Sampling, and Reporting, Tuolumne Utilities District Wastewater Reclamation System, Tuolumne County, California," dated April 6, 2006 which focused on the monitoring of shallow or first encountered groundwater on the largest of the Rosasco and Gardella parcels.

The workplan was subsequently approved in a RWQCB review letter titled "Complete Groundwater Monitoring Work Plan, Tuolumne Utilities District, Tuolumne County" dated May 17, 2007.

## **2.1. MONITORING WELL INSTALLATION**

Eleven monitoring wells, M-6 through M-16, were installed on the Rosasco and Gardella sites between October 24 and November 6, 2007. The details of the monitoring well installation were documented in a report prepared by Kleinfelder titled "Monitoring Well Installation, Tuolumne Utilities District, Wastewater Reclamation System, Rosasco and Gardella Properties, Tuolumne County, California" (ST08R627, dated June 27, 2008)

The following table summarizes the monitoring well locations and positions relevant to surface topography and existing reclamation system features.

**TEXT TABLE 1**  
**MONITORING WELL LOCATIONS**

	Monitoring Well Designation	Location
<b>Rosasco</b>	<b>M-6</b>	Northwest and up-slope of Rosasco Northeastern Storage Pond
	<b>M-7</b>	West/southwest and down-slope of Rosasco Northeastern Storage Pond
	<b>M-8</b>	South and down-slope of Rosasco Northeastern Storage Pond
	<b>M-9</b>	Northwest and up-slope of Rosasco application field
	<b>M-10</b>	South and down-slope of Rosasco application fields
	<b>M-11</b>	South/southwest and adjacent downslope to Rosasco Tailwater Return Pond
<b>Gardella</b>	<b>M-12</b>	North and up-slope of Gardella Storage Pond
	<b>M-13</b>	West and down-slope of Gardella Storage Pond
	<b>M-14</b>	South/southwest and down-slope of Gardella Storage Pond
	<b>M-15</b>	West and down-slope of Gardella application fields
	<b>M-16</b>	South and down-slope of Gardella Tailwater Return Pond

Subsurface water was encountered during installation of the wells at depths ranging from approximately 13 to 24 feet bgs in six of the eleven wells. Free water was not initially noted in the two up-gradient locations on the Rosasco site, nor in the three wells located around the perimeter of the of the Gardella storage pond, although water has infiltrated into two of the three Gardella wells since installation. The total depths of the wells ranged from 8.2 to 33.5 feet bgs. The depth of the uppermost soil layers encountered at the site ranged from approximately 3.5 feet in the higher topographical areas of the site to approximately 25 feet in lower topographical areas. Rocks underlying the soils included slate, sandstone, claystone, shale, and tuff. In some locations soil layers were encountered between layers of rock. Refusal or difficult drilling conditions were encountered at the total depth of most of the borings. The following text table details the construction of the 2-inch diameter monitoring wells.

**TEXT TABLE 2**  
**MONITORING WELL CONSTRUCTION DETAIL**

	Monitoring Well Designation	Total Depth Well (feet)	Screened Interval (feet)	Filter Pack Interval (feet)	Bentonite Seal (feet)	Grout Seal (feet)
<b>Rosasco</b>	<b>M-6</b>	16.5	16.5 to 6.5	16.5 to 4.5	4.5 to 2.5	2.5 to 0
	<b>M-7</b>	30	30 to 15	30 to 13	13 to 9.5	9.5 to 0
	<b>M-8</b>	16	16 to 6	16 to 4.5	4.5 to 2	2 to 0
	<b>M-9</b>	23	23 to 8	23 to 5.5	5.5 to 3	3 to 0
	<b>M-10</b>	29	29 to 14	29 to 12.5	12.5 to 9.5	9.5 to 0
	<b>M-11</b>	26	26 to 11	26 to 10	10 to 7	7 to 0
<b>Gardella</b>	<b>M-12</b>	33.5	33.5 to 18.5	33.5 to 16.5	16.5 to 13	13 to 0
	<b>M-13</b>	8.5	8.5 to 3.5	8.5 to 3	3 to 2	2 to 0
	<b>M-14</b>	20	20 to 5	20 to 4	4 to 2	2 to 0
	<b>M-15</b>	15	15 to 5	15 to 4	4 to 2	2 to 0
	<b>M-16</b>	16.5	16.5 to 6.5	17 to 4.5	4.5 to 2	2 to 0

Note: All measurements were estimated relative to the ground surface at the time of drilling.

The following text table displays the monitoring well elevations and subsequent screened interval elevations following well development and survey.

**TEXT TABLE 3**  
**MONITORING WELL CONSTRUCTED ELEVATIONS**

	Monitoring Well Designation	Approximate Total Depth Well (feet)	Screened Length (feet)	Top of Casing Elevation (msl)	Approximate Bottom of Screen Elevation (msl)	Approximate Top of Screen Elevation (msl)
<b>Rosasco</b>	<b>M-6</b>	16.5	10	1363.89	1347	1357
	<b>M-7</b>	33	15	1341.39	1308	1323
	<b>M-8</b>	18.56	10	1334.83	1316	1326
	<b>M-9</b>	26.5	15	1345.26	1319	1334
	<b>M-10</b>	31.87	15	1297.94	1266	1281
	<b>M-11</b>	28.01	15	1295.35	1267	1282
<b>Gardella</b>	<b>M-12</b>	34.0	15	1290.81	1257	1272
	<b>M-13</b>	8.4	5	1261.52	1253	1258
	<b>M-14</b>	21.56	15	1259.41	1238	1253
	<b>M-15</b>	15.12	10	1222.75	1208	1218
	<b>M-16</b>	19.72	10	1215.14	1195	1205

Note: The total depth measurement was made from the finished top of well casing. The top of casing elevation survey was also conducted from the top of the finished well casings. The screened interval elevations are based on well installation observations, installed screen length of each well, and surveyed TOC elevations.

## 2.2. INTERIM GROUNDWATER LIMITATIONS

Groundwater samples were collected from the monitoring well network on a quarterly basis for four consecutive quarters. The groundwater samples were analyzed for the following list of analytes in accordance with the groundwater monitoring list of constituents as shown in the WDR and compared to the interim groundwater limitations, also shown.



**TEXT TABLE 4**  
**INTERIM GROUNDWATER LIMITATIONS**

Analyte	Units	Interim Groundwater Limitation
Boron	mg/l	0.7 <sup>a, b</sup>
Chloride	mg/l	106 <sup>a, b</sup>
Iron	mg/l	0.3 <sup>a, b</sup>
Manganese	mg/l	0.05 <sup>a, b</sup>
Sodium	mg/l	69 <sup>a, b</sup>
Total Coliform	MPN/100 ml	<2.2
Total Dissolved Solids	mg/l	450 <sup>a, b</sup>
Nitrate as N	mg/l	10 <sup>a, b</sup>
Total Kjeldahl Nitrogen	mg/l	NA
Bromoform	ug/l	4 <sup>a, b</sup>
Bromodichloromethane	ug/l	0.27 <sup>a, b</sup>
Chloroform	ug/l	1.1 <sup>a, b</sup>
Dibromochloromethane	ug/l	0.37 <sup>a, b</sup>
pH	S.U.	6.5-8.5 <sup>a, b</sup>

mg/l = milligrams per liter

ug/l = micrograms per liter

MPN = Most Probable Number

a = WDR specified groundwater limitation

b = CalEPA Water Quality Goal

### 3 GROUNDWATER MONITORING DATA

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The following sections present the results of groundwater monitoring events conducted between the fourth quarter 2007 and the third quarter 2008 in addition to a summary of the reported effluent quality contained in Quartz Reservoir.

#### 3.1. GROUNDWATER ELEVATIONS AND GRADIENTS

The locations of new monitoring wells, and the elevation of the top of the PVC well casings were surveyed during the first quarter of 2008 by Professional Land Surveyor Jack Gnipp (License No. 7698) of the TUD. According to Mr. Gnipp, the datum for the survey is CCS Zone 3 Northings and Eastings (US survey feet), NAVD88 Elevations (US Survey feet) and NAD83 Latitudes and Longitudes (decimal degrees). A measuring point was marked on the north side of each well casing for both well surveying and depth to water measuring points.

The surveyed well casings were used to calculate the groundwater elevation in each well during the monitoring period by subtracting the depth to water measurement from the top of each well casing elevation. The resulting groundwater elevations from each site were then used to contour the occurrence of shallow subsurface water at each site, respectively. It should be noted that the Rosasco and Gardella sites are spatially separated by approximately 2 miles. The Rosasco site resides northwest of Gardella at an approximate ground surface elevation of 1,300 feet above amsl while the Gardella site is at approximately 1,250 feet above msl. There is a slight drainage divide (bedrock outcrop) located south of the Rosasco site which may preclude the mixing of sprayfield waters between the two sites (either by uncollected surface water runoff or shallow groundwater movement). Although Kleinfelder was not actively involved with monitoring activities around Quartz Reservoir, the groundwater data was forwarded to Kleinfelder by TUD, and thus included in this discussion as additional background information.

The depth to groundwater on the Rosasco site is generally deeper (18 feet average) than the Gardella site (14 feet average) and coincides with a relatively deeper monitoring well

network installation for Rosasco and Gardella, respectively; which also shows an overall thicker soil profile on Rosasco versus Gardella. The depth to groundwater in the monitoring wells at Quartz Reservoir was not reported by TUD at this time.

The groundwater gradient at the Rosasco site was estimated to flow in general conformance with the topography of the site and flowed to the southeast. Similarly, the shallow occurrence of groundwater on the Gardella site appeared to follow topography and flowed to the southwest. Groundwater contour maps for each site have been included and are shown in Plates 3A through 3D for the Rosasco property and Plates 3E through 3H for the Gardella site. The groundwater level and elevation data for the Rosasco and Gardella sites are compiled in Table 1 attached to this report.

### **3.2. GROUNDWATER QUALITY**

The subsurface water quality from across both sites was assessed temporally and spatially as relevant to the application fields and storage ponds. The shallow groundwater quality at the Rosasco site was shown to exhibit generally lower average concentrations of constituents such as TDS, sodium, and chloride in the furthest upgradient wells M-7 and M-8 (located upgradient of the eastern portion of the application field) versus the concentrations noted in the downgradient wells M-10 (except sodium) and M-11. It was noted that M-11 is located near the Rosasco eastern tailwater return pond and may account for higher average analyte concentrations because water appears to flow in that direction and collect there. A comparison of groundwater quality of upgradient conditions to the Rosasco northeastern storage pond could not be made at this time because the well (M-6) located upslope of the storage pond has been dry during this assessment period. Similarly, the well (M-9) located upslope from the application field has also been dry.

The subsurface water quality beneath the Gardella site showed higher concentrations of TDS, chloride, iron, manganese, sodium, and boron in the upgradient monitoring locations M-12, M-13, and M-14 versus M-15, and M-16 located downgradient.

Table 2, attached to this report, displays the analytical results for each monitoring location during four quarterly sampling events. The following text tables display the

range of detected analytes from all of the monitoring wells at the Rosasco (Text Table 5) and Gardella (Text Table 6) sites during the past four quarters.

**TEXT TABLE 5**  
**GROUNDWATER ANALYTICAL RESULTS (ROSASCO)**  
**OCTOBER 2007 TO SEPTEMBER 2008**

	Analyte	Units	Concentration Range
<b>Rosasco Site</b>	Nitrate as N	mg/l	ND (<0.50) to 8.7
	TKN	mg/l	ND (<0.20) to 1.1
	TDS	mg/l	510 to 1,200
	Chloride	mg/l	39 to 320
	Iron	mg/l	ND (<0.10) to 0.66
	Manganese	mg/l	ND (<0.02) to 0.79
	Sodium	mg/l	42 to 120
	Boron	mg/l	ND (<0.05) to 0.27
	Total Trihalomethanes	ug/l	All ND (<0.50)
	Total Coliform	MPN/ 100 ml	ND (<1.1) to >23
	pH	S.U.	6.77 to 7.36

mg/l = milligrams per liter

ug/l = micrograms per liter

MPN = Most Probable Number

S.U. = Standard Units

ND= non detectable at or above the laboratory reporting limit

**TEXT TABLE 6**  
**GROUNDWATER ANALYTICAL RESULTS (GARDELLA)**  
**OCTOBER 2007 TO SEPTEMBER 2008**

	Analyte	Units	Concentration Range
<b>Gardella Site</b>	Nitrate as N	mg/l	ND (<0.50) to 10
	TKN	mg/l	ND (<0.20) to 2.1
	TDS	mg/l	430 to 1,400
	Chloride	mg/l	54 to 610
	Iron	ug/l	ND (<0.10) to 6.8
	Manganese	ug/l	ND (<0.02) to 1.8
	Sodium	ug/l	49 to 250
	Boron	ug/l	ND (<0.05) to 0.52
	Total Trihalomethanes	ug/l	All ND (<0.50)
	Total Coliform	MPN/ 100 ml	ND (<1.1) to >23
	pH	S.U.	6.71 to 7.61

mg/l = milligrams per liter

ug/l = micrograms per liter

MPN = Most Probable Number

S.U. = Standard Units

ND= non detectable at or above the laboratory reporting limit

### 3.3. EFFLUENT QUALITY

A surface water sample was collected by TUD staff in December 2008. The following text table shows the reported concentrations of select analytes (those which match the list of required groundwater analytes) from the effluent within Quartz Reservoir. A copy of the complete report of analytical results can be found in Appendix A.

**TEXT TABLE 7**  
**EFFLUENT ANALYTICAL RESULTS (QUARTZ RESERVOIR)**  
**DECEMBER 4, 2008**

	Analyte	Units	Concentration
Quartz Reservoir	Nitrate as N	mg/l	2.4
	Chloride	mg/l	53
	Iron	mg/l	0.182
	Sodium	mg/l	50
	Chloroform (Trihalomethane)	ug/l	0.5

mg/l = milligrams per liter

ug/l = micrograms per liter

## **4 BACKGROUND GROUNDWATER QUALITY ASSESSMENT METHODOLOGY**

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The goal of this study is to present a summary of monitoring data, evaluate the background subsurface water quality, and compare the background water quality to that in the wells used to monitor Quartz Reservoir, and the sensitive ponds and land application areas located on the Rosasco and Gardella properties as noted in the previous quarterly monitoring reports.

This study is based on subsurface water monitoring of the Rosasco and Gardella sprayfields and effluent data from the Quartz Reservoir.

### **4.1. EVALUATION OF BACKGROUND WATER QUALITY**

The evaluation of the background subsurface water quality was made in accordance with the methods described in Title 27 CCR Section 20415 (e)(10). The two acceptable methods as described in Title 27 CCR Section 20415 (e)(10) are; (A) By Reference to Historical Data, whereby each constituent or parameter does not show appreciable variation; or (B) By Using a Formula/Procedure whereby establishing and updating a background value for a constituent or parameter in order to reflect changes in the background water quality if the pooled data provides the greatest power to the data analysis.

The method chosen for this assessment was the reference to historical data due to the low variability of individual constituent concentrations over the time period monitored. Depth to subsurface water data was not provided from the five Quartz Reservoir monitoring wells, and a groundwater gradient could not be calculated, thus they were not used in the evaluation of background water quality.

First, the background monitoring points were identified for each property (Rosasco and Gardella) by assessing the observed subsurface water elevations. The historically highest subsurface water elevations identified at the Rosasco site were in wells M-7 and M-8. Both M-7 and M-8 are located upslope and upgradient of the application field. M-6

or M-9 (located upslope from M-7 and M-8 near the north side of the Rosasco Northeastern Storage Pond and upslope from the northwest portion of the application field, respectively) were not used as background points because both have been dry. It should be noted that the Rosasco Northeastern Storage Pond is seldom filled and used to store application water.

The historically highest subsurface water elevations identified at the Gardella site were in well M-12. M-12 is located upslope and upgradient of both the Gardella Storage Pond and the application field.

The reported concentrations of each constituent were averaged over the time monitored in each background monitoring point. For the Rosasco application field, we averaged both M-7 and M-8 together because they are located within relatively close proximity of each other and both are located upgradient and at similar elevations to the application field. For the Gardella site we used M-12 because it is located upgradient to the storage pond and application field. When a constituent was not detected during any given quarterly monitoring event and yet had been detected any time within the assessment period, we used one-half of laboratory detection limit as a minimum value while averaging. If a constituent has never been detected, we used a non-detectable (ND) notation in the following Table 8 which displays the average concentration for each background monitoring well(s) at the Rosasco and Gardella application fields and the overall background average concentration of both sites.



**TEXT TABLE 8**  
**AVERAGED BACKGROUND SUBSURFACE WATER CONCENTRATIONS**

Constituent	Units	Rosasco Property M-7/M-8 (avg)	Gardella Property M-12 (avg)	Background Concentration, M-7, M-8, M-12 (avg)
Boron	mg/l	0.21	0.42	0.3
Chloride	mg/l	71.87	290	180.9
Iron	mg/l	0.24	1.15	0.7
Manganese	mg/l	0.60	1.55	1.1
Sodium	mg/l	61.5	155	108.3
Total Coliform	MPN/100ml	6.9	14.1	10.5
Total Dissolved Solids	mg/l	625	975	800
Nitrate as N	mg/l	0.62	0.96	0.79
Total Kjeldahl Nitrogen	mg/l	0.50	0.80	0.65
Bromoform	ug/l	ND	ND	ND
Bromodichloromethane	ug/l	ND	ND	ND
Chloroform	ug/l	ND	ND	ND
Dibromochloromethane	ug/l	ND	ND	ND
pH	S.U.	7.1	6.71	6.9

mg/l = milligrams per liter

ug/l = micrograms per liter

MPN = Most Probable Number

S.U. = Standard Units

ND= non detectable at or above the laboratory reporting limit

#### **4.2. BACKGROUND WATER QUALITY VS. ON-SITE WATER QUALITY**

The on-site subsurface water quality data collected from all of the monitoring wells during the period of this assessment were compared to the averaged background water quality. Text Table 9 below shows the background water quality as shown above

compared to the average on-site water quality collected from downgradient locations at each site, including ponds and application fields and wells.

**TEXT TABLE 9**  
**BACKGROUND GROUNDWATER CONCENTRATIONS VS.**  
**ON-SITE GROUNDWATER QUALITY**

Constituent	Units	Background Concentration	On-Site Groundwater Quality		
			Rosasco	Gardella	
Monitoring/Compliance Locations			Field (M-10, M-11)	Pond (M13, M14)	Field (M15, M16)
Boron	mg/l	0.3	0.05	0.42	0.15
Chloride	mg/l	180.9	208.75	418.5	145
Iron	mg/l	0.7	0.19	0.44	1.08
Manganese	mg/l	1.1	0.03	0.07	0.15
Sodium	mg/l	108.3	75	225	80.25
Total Coliform	MPN/100ml	10.5	10.6*	16.4*	19.6*
Total Dissolved Solids	mg/l	800	854	1175	682
Nitrate as N	mg/l	0.79	6.57	5.48	0.63
Total Kjeldahl Nitrogen	mg/l	0.65	0.41	0.33	0.50
Bromoform	ug/l	ND (<0.5)	ND (<0.5)	ND (<0.5)	ND (<0.5)
Bromodichloromethane	ug/l	ND (<0.5)	ND (<0.5)	ND (<0.5)	ND (<0.5)
Chloroform	ug/l	ND (<0.5)	ND (<0.5)	ND (<0.5)	ND (<0.5)
Dibromochloromethane	ug/l	ND (<0.5)	ND (<0.5)	ND (<0.5)	ND (<0.5)
pH	S.U.	6.9	6.88	7.28	7.30

\* = Total Coliform Organism values averaged using reported concentrations no greater than 23 MPN/100ml in cases where the reported value was > 23 MPN/100 ml. The actual value may be greater than the average shown here.

#### 4.3. BACKGROUND AND ON-SITE GROUNDWATER QUALITY VS. INTERIM GROUNDWATER LIMITATIONS

The following text table displays the average background and on-site groundwater quality concentrations in the compliance background monitoring wells and the interim groundwater limitations noted in the WDR or the CalEPA Water Quality Goals if not specified.

**TEXT TABLE 10  
BACKGROUND AND ON-SITE GROUNDWATER CONCENTRATIONS VS.  
INTERIM GROUNDWATER LIMITATIONS**

Constituent/ Units	Effluent Quality (Dec 2008)	Background Concentration (average) (M-7, M-8, M-12)	On-Site Groundwater Quality			Interim Groundwater Limitation
			Rosasco (average)	Gardella (average)		
				Field (M-10, M-11)	Pond (M13, M14)	
Boron (mg/l)	na	0.3	0.05	0.42	0.15	0.7
Chloride (mg/l)	53	180.9	208.75	418.5	145	106
Iron (mg/l)	182	0.7	0.19	0.44	1.08	0.3
Manganese (mg/l)	na	1.1	0.03	0.07	0.15	0.05
Sodium (mg/l)	50	108.3	75	225	80.25	69
Total Coliform (MPN/100ml)	na	10.5	10.6*	16.4*	19.6*	<2.2
Total Dissolved Solids (mg/l)	na	800	854	1175	682	450
Nitrate as N (mg/l)	2.4	0.79	6.57	5.48	0.63	10
Total Kjeldahl Nitrogen (mg/l)	na	0.65	0.41	0.33	0.50	NA
Bromoform (ug/l)	Na	ND	ND (<0.5)	ND (<0.5)	ND (<0.5)	4.0
Bromodichloro- methane (ug/l)	na	ND	ND (<0.5)	ND (<0.5)	ND (<0.5)	0.27
Chloroform (ug/l)	0.5	ND	ND (<0.5)	ND (<0.5)	ND (<0.5)	1.1
Dibromochloro- methane (ug/l)	na	ND	ND (<0.5)	ND (<0.5)	ND (<0.5)	0.37
pH (S.U.)	na	6.9	6.88	7.28	7.30	6.5-8.5

Bold = Concentration greater than Interim Groundwater Limitation  
 mg/l = milligrams per liter  
 ug/l = micrograms per liter  
 laboratory reporting limit.  
 Na= not applicable or not included in analyses by TUD.

S.U. = Standard Units  
 MPN = Most Probable Number  
 ND= non detectable at or above the

## 5 DISCUSSION OF FINDINGS AND RECOMMENDATIONS

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The goal of this study is to present a summary of monitoring data, calculate the background water quality, and compare the background water quality to that in the wells used to monitor the sensitive ponds and land application areas located on the Rosasco and Gardella properties as noted in the previous quarterly monitoring reports. The discussion of findings and recommendations based upon the results of the subsurface water background monitoring assessment is presented in the following sections.

### 5.1. DISCUSSION OF FINDINGS

#### **Background Evaluation**

The background groundwater quality was estimated using the historical data collected from all of the compliance monitoring points over four consecutive quarters (October 2007 to September 2008) in accordance with Title 27 CCR Section 20415 (e)(10). The monitoring points located furthest upslope in each of the application fields and storage ponds (where applicable) were used to assess the background water quality since shallow subsurface water elevations generally mimic surface topography. Each application field displays a relatively uniform slope. The Rosasco site slopes toward the south/southeast, and the Gardella site slopes toward the southwest.

The background water quality was assessed at the Rosasco site with monitoring points M-7 and M-8. Both M-7 and M-8 are located within approximately 500 feet of each other and have similar ground surface elevations. Although M-7 is 33 feet deep and M-8 is 18.56 feet deep, the depth to water in each well is approximately 15 feet bgs. Both M-7 and M-8 are located above the eastern portion of the Rosasco application field and south of and downhill of the Rosasco Northeastern Storage Pond. The Rosasco Northeastern Storage Pond is typically dry and not used to store wastewater. One monitoring point (M-6) is located upslope to the storage pond, but has been historically dry; thus M-6 was not used as a background assessment point.

The background water quality was assessed at the Gardella site using monitoring point M-12. M-12 is located both upslope and hydraulically upgradient to the Gardella Storage Pond and application field.

The water quality for each background monitoring point was assessed by averaging the concentrations over the monitoring period. The average concentrations at the Rosasco and Gardella sites were used to establish a general overall background concentration for the occurrence of shallow subsurface water at both sites. The estimated background water concentrations are shown in Text Table 7.

The background water quality, including background wells, was compared to the observed subsurface water quality from the downgradient monitoring points to the storage ponds and application fields, effluent water quality, and interim groundwater limitations. In general, the Rosasco and Gardella site's water quality was poorer than the effluent quality. Only iron was higher concentration in the effluent versus the average background quality, and chloroform was detected in the effluent, whereas neither chloroform nor any other trihalomethane byproduct has been detected in any of the monitoring wells. At the Rosasco site, the average concentrations of chloride, TDS, and nitrate as N were higher than the estimated background concentrations; whereas iron, manganese, sodium, TKN, and pH were lower than the background concentration in the downgradient monitoring points (M-10 and M-11) (see Text Table 9). The concentrations of iron, manganese, sodium, TKN, and pH appear to decrease with distance from the initial upslope flood irrigation application points within the field.

The presence and concentration of iron and manganese in soil at these sites are anticipated to be relatively higher as they are closer to the source rock (e.g., Table Mountain, basalt flow).

The average concentration of coliform bacteria was noted to be higher than the interim limitation; however, given the shallow soil profile and current cattle grazing practices in and around each application field, it should be anticipated that coliform bacteria will be present and background values may typically exceed the interim limitation.

At the Gardella site, the observed downgradient concentrations to the storage pond (M-13 and M-14) showed the average concentrations of boron, chloride, sodium, TDS, nitrate as N, and pH were higher than the averaged background concentration, and iron, manganese, and TKN were lower. Most all of the analytes appear to decrease with distance from the initial upslope application point. With the exception of iron, each of the requested analytes from downgradient wells M-15 and M-16 were found to be below averaged background values (see Text Table 9).

The estimated background water quality for chloride, iron, manganese, sodium, coliform, and TDS exceeded the interim groundwater limitations (Text Table 10). The averaged concentrations of chloride, iron, manganese, sodium, coliform, and TDS in all of the downgradient wells on the Gardella site and only chloride, sodium, coliform, and TDS on the Rosasco site exceeded the background groundwater quality and interim groundwater limitations (Text Table 10). It should be noted that the two downgradient wells located directly adjacent to the Gardella Storage Pond (M-13 and M-14) have little or no vegetation nearby for the uptake of nutrients and may contribute to elevated concentrations above background of sodium, chloride, and TDS compared to the furthest downgradient wells located southwest of the application field (M-15 and M-16). It appears that the uptake of nutrients across the application field is sufficient for most nutrients as the concentration of sodium, chloride, and TDS decrease with distance to concentrations below background.

The overall water quality beneath the Rosasco site appears to be of a better quality than the water beneath the Gardella site, for both the upgradient and downgradient monitoring points. This may be a function of the total thickness of the soil profile in which the monitoring wells are installed. The soil profile appeared to be generally thicker on the Rosasco site versus the Gardella site and thus may offer a thicker soil profile for applied water to percolate through. Crops are also actively grown on the Rosasco site which would typically uptake more nutrients in contrast to the Gardella site which is primarily used for cattle grazing. Additionally, it should be noted that a vast area of the northern portion of the Gardella site is depicted on the USGS 7.5 minute

movement, thereby inhibiting nutrient uptake. The extent of the dredge tailings has not been defined by Kleinfelder at this time and was not part of this scope.

### **Study Limitations**

- This study did not include the constituents listed in the WDR annual list of analytes because they have only one data set.
- This study did not include an assessment of background water quality at Quartz Reservoir because depth to groundwater data was not supplied to Kleinfelder by TUD.
- This study did not include an assessment of the ponds on the Rosasco site because the well (M-6) located upslope from the pond was dry.
- This study did not include an assessment or characterization of the wastewater quality variability throughout the year. Only one sample event was reported to Kleinfelder at the time of this report.

### **5.2. RECOMMENDATIONS**

Based on our assessment, the following groundwater limitations are recommended:

- 1) Kleinfelder recommends that the interim groundwater limitations for boron, chloride, sodium, nitrate as N, trihalomethanes, and pH remain the same.

- 2) In accordance with the WDR, where the background concentrations are greater than the interim limitations, alternative limitations have been recommended. The average concentrations of iron, manganese, TDS, chloride, and sodium were higher than the interim groundwater limitations. We recommend the final groundwater limitations for these same constituents be increased to at least the average background groundwater concentrations observed over the past four quarters as shown in the following Text Table 11.

**TEXT TABLE 11**  
**RECOMMENDED GROUNDWATER LIMITATIONS**

Constituent	Units	Background Groundwater Quality	Interim Groundwater Limitation	Recommended Groundwater Limitation
Boron	mg/l	0.3	0.7	Same
Chloride	mg/l	180.9	106	181
Iron	mg/l	0.7	0.3	0.7
Manganese	mg/l	1.1	0.05	1.1
Sodium	mg/l	108	69	108
Total Coliform	MPN/100ml	10.5	<2.2	10.5
Total Dissolved Solids	mg/l	800	450	800
Nitrate as N	mg/l	0.79	10	Same
Total Kjeldahl Nitrogen	mg/l	0.65	NA	NA
Bromoform	ug/l	ND	4.0	Same
Bromodichloromethane	ug/l	ND	0.27	Same
Chloroform	ug/l	ND	1.1	Same
Dibromochloromethane	ug/l	ND	0.37	Same
pH	S.U.	6.9	6.5-8.5	Same

- 3) We recommend the background groundwater quality be re-assessed each year in accordance with the WDR.



Per your request, Kleinfelder has forwarded a copy of this report to the RWQCB.

This report is subject to the "Limitations" presented in Chapter 6 of this report. Any party other than TUD or regulatory agencies having enforcement jurisdiction for this site) who would like to use this report shall notify Kleinfelder of such intended use by requesting permission in writing.

## 6 LIMITATIONS

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Kleinfelder has prepared this report in accordance with the generally accepted standards of care, which exist in Tuolumne County at the time of writing. It should be recognized that definition and evaluation of geologic and chemical subsurface conditions are difficult. Judgments leading to conclusions and recommendations are generally made with an incomplete knowledge of the subsurface and/or historic conditions applicable to the site. More extensive studies may further reduce the uncertainties associated with this assessment. Kleinfelder should be notified for additional consultation if the client wishes to reduce the uncertainties beyond the level associated with this report. No warranty, expressed or implied, is made.

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## TABLES

TABLE 1

Depth to Groundwater and Elevations (Feet)  
Wastewater Reclamation System  
Rosasco and Gardella Properties  
Tuolumne Utilities District

WELL NO.	LOCATION	DATE OF WATER LEVEL MEASUREMENTS	ELEVATION (N. RIM OF PVC CASING)	DEPTH TO GROUNDWATER	GROUNDWATER ELEVATION
M-6	North and upslope of Rosasco Northeastern Storage Pond	10/30/2007	1363.89	Dry	NA
		3/18/2008	1363.89	Dry	NA
		6/24/2008	1363.89	Dry	NA
		9/22/2008	1363.89	Dry	NA
		12/29/2008	1363.89	Dry	NA
M-7	West and downslope of Rosasco Northeastern Storage Pond	10/30/2007	1341.39	14.61	1326.78
		3/18/2008	1341.39	11.01	1330.38
		6/24/2008	1341.39	12.89	1328.50
		9/22/2008	1341.39	14.65	1326.74
		12/29/2008	1341.39	15.62	1325.77
M-8	South and downslope of Rosasco Northeastern Storage Pond	10/30/2007	1334.83	14.87	1319.96
		3/18/2008	1334.83	11.24	1323.59
		6/24/2008	1334.83	13.51	1321.32
		9/22/2008	1334.83	15.02	1319.81
		12/29/2008	1334.83	15.60	1319.23
M-9	Upslope of Rosasco Application Field	10/30/2007	1345.26	Dry	NA
		3/18/2008	1345.26	Dry	NA
		6/24/2008	1345.26	Dry	NA
		9/22/2008	1345.26	Dry	NA
		12/29/2008	1345.26	Dry	NA
M-10	Downslope of Rosasco Application Field	10/30/2007	1297.94	20.50	1277.44
		3/18/2008	1297.94	19.22	1278.72
		6/24/2008	1297.94	19.66	1278.28
		9/22/2008	1297.94	20.58	1277.36
		12/29/2008	1297.94	21.01	1276.93
M-11	Adjacent to Rosasco Tailwater Return Pond	10/30/2007	1295.35	21.00	1274.35
		3/18/2008	1295.35	19.68	1275.67
		6/24/2008	1295.35	20.43	1274.92
		9/22/2008	1295.35	21.15	1274.20
		12/29/2008	1295.35	21.28	1274.07

TABLE 1

Depth to Groundwater and Elevations (Feet)  
Wastewater Reclamation System  
Rosasco and Gardella Properties  
Tulalume Utilities District

WELL NO.	LOCATION	DATE OF WATER LEVEL MEASUREMENTS	ELEVATION (N. RIM OF PVC CASING)	DEPTH TO GROUNDWATER	GROUNDWATER ELEVATION
M-12	Upslope of Gardella Storage Pond	11/8/2007	1290.81	Dry	NA
		3/18/2008	1290.81	28.36	1262.45
		6/24/2008	1290.81	29.25	1261.56
		9/22/2008	1290.81	30.10	1260.71
		12/29/2008	1290.81	31.49	1259.32
M-13	Southwest and downslope of Gardella Storage Pond	11/8/2007	1261.52	Dry	NA
		3/18/2008	1261.52	3.82	1257.70
		6/24/2008	1261.52	6.96	1254.56
		9/22/2008	1261.52	Dry	NA
		12/29/2008	1261.52	Dry	NA
M-14	Southwest and downslope of Gardella Storage Pond	11/8/2007	1259.41	Dry	NA
		3/18/2008	1259.41	7.36	1252.05
		6/24/2008	1259.41	8.61	1250.80
		9/22/2008	1259.41	9.97	1249.44
		12/29/2008	1259.41	7.36	1252.05
M-15	Downslope of Gardella Application Field	11/8/2007	1222.75	7.90	1214.85
		3/18/2008	1222.75	3.96	1218.79
		6/24/2008	1222.75	6.23	1216.52
		9/22/2008	1222.75	7.50	1215.25
		12/29/2008	1222.75	5.90	1216.85
M-16	Downslope of Gardella Tailwater Retun Pond	11/8/2007	1215.14	8.25	1206.89
		3/18/2008	1215.14	4.91	1210.23
		6/24/2008	1215.14	5.88	1209.26
		9/22/2008	1215.14	8.41	1206.73
		12/29/2008	1215.14	4.53	1210.61

TABLE 2  
Concentrations of Analytes in Groundwater  
Wastewater Reclamation System  
Rosasco and Gardella Sites  
Tuolumne Utilities District

Monitoring Well #	Sample Date	pH	Nitrate as N (mg/l)	Total Kjeldahl Nitrogen (mg/l)	Total Dissolved Solids (mg/l)	Chloride (mg/l)	Total THMs (µg/l)	Iron (mg/l)	Manganese (mg/l)	Sodium (mg/l)	Boron (mg/l)	Total Coliform Organisms (MPN/100 ml)
M-6	10/30/2007	Dry	Well									
	3/18/2007	Dry	Well									
	6/24/2008	Dry	Well									
	9/22/2008	Dry	Well									
M-7	10/30/2007	7.36	ND (<0.50)	0.88	590	62	ND (<0.50)	ND (<0.10)	0.13	52	0.18	>23.0
	3/18/2007	7	1.1	1.1	740	93	ND (<0.50)	0.64	0.11	50	0.18	1.1
	6/24/2008	7.01	ND (<0.50)	0.56	700	57	ND (<0.50)	0.11	0.10	46	0.16	3.6
	9/22/2008	7.29	ND (<0.50)	0.38	700	59	ND (<0.50)	ND (<0.10)	0.09	54	0.19	ND (<1.1)
M-8	10/30/2007	7.20	ND (<0.50)	0.31	550	100	ND (<0.50)	ND (<0.10)	0.39	97	0.27	>23.0
	3/18/2007	6.98	0.86	0.31	640	110	ND (<0.50)	0.63	0.57	73	0.22	ND (<1.1)
	6/24/2008	6.99	ND (<0.50)	0.21	570	55	ND (<0.50)	0.13	0.07	63	0.22	1.1
	9/22/2008	7.18	ND (<0.50)	ND (<0.20)	510	39	ND (<0.50)	0.15	0.79	57	0.22	ND (<1.1)
M-9	10/30/2007	Dry	Well									
	3/18/2007	Dry	Well									
	6/24/2008	Dry	Well									
	9/22/2008	Dry	Well									
M-10	10/30/2007	6.79	8.7	0.33	580	130	ND (<0.50)	ND (<0.10)	0.016	55	ND (<0.05)	>23.0
	3/18/2007	6.8	8.6	ND (<0.20)	630	130	ND (<0.50)	0.29	ND (<0.02)	47	ND (<0.05)	>23.0
	6/24/2008	6.77	8.5	0.28	690	120	9/22/2008	ND (<0.10)	ND (<0.02)	47	ND (<0.05)	3.6
	9/22/2008	6.87	8.7	ND (<0.20)	650	150	ND (<0.50)	ND (<0.10)	ND (<0.02)	42	ND (<0.05)	ND (<1.1)
M-11	10/30/2007	7.01	4.8	0.45	980	280	ND (<0.50)	ND (<0.10)	0.089	100	ND (<0.05)	>23.0
	3/18/2007	6.9	5.5	1.0	1,000	250	ND (<0.50)	0.66	ND (<0.02)	96	0.06	9.2
	6/24/2008	6.91	4.5	0.41	1,200	290	ND (<0.50)	ND (<0.10)	ND (<0.02)	93	ND (<0.05)	1.1
	9/22/2008	6.96	3.3	0.44	1,100	320	ND (<0.50)	ND (<0.10)	ND (<0.02)	120	ND (<0.05)	ND (<1.1)

**TABLE 2**  
Concentrations of Analytes in Groundwater  
Wastewater Reclamation System  
Rosasco and Gardella Sites  
Tuolumne Utilities District

Monitoring Well #	Sample Date	pH	Nitrate as N (mg/l)	Total Kjeldahl Nitrogen (mg/l)	Total Dissolved Solids (mg/l)	Chloride (mg/l)	Total THMs (µg/l)	Iron (mg/l)	Manganese (mg/l)	Sodium (mg/l)	Boron (mg/l)	Total Coliform Organisms (MPN/100 ml)
M-12	11/8/2007	Dry	Well									
	3/19/2008	6.71	1.2	1.1	1,000	330	ND (<0.50)	1.2	1.3	170	0.47	12
	6/24/2008	6.71	0.72	0.56	950	250	ND (<0.50)	1.1	1.8	140	0.37	16.1
	9/22/2008	Well Obstruction										
M-13	11/8/2007	Dry	Well									
	3/19/2008	7.51	10	0.61	1,100	400	ND (<0.50)	0.20	0.03	250	0.38	>23.0
	6/24/2008	7.38	5.1	0.27	1,100	360	ND (<0.50)	0.68	0.021	250	0.39	1.1
	9/22/2008	Dry	Well									
M-14	11/8/2007	Dry	Well									
	3/19/2008	7.15	4.8	0.28	1,400	610	ND (<0.50)	0.044	0.2	250	0.52	>23.0
	6/24/2008	7.19	4.0	ND (<0.20)	1,400	480	ND (<0.50)	1.20	0.08	200	0.43	>23.0
	9/22/2008	7.18	3.5	0.29	950	280	ND (<0.50)	ND (<0.10)	ND (<0.02)	150	0.36	12
M-15	11/8/2007	7.61	0.54	0.41	640	240	ND (<0.50)	0.11	0.077	150	0.30	>23.0
	3/19/2008	7.55	1.3	ND (<0.20)	580	160	ND (<0.50)	0.6	0.082	110	0.27	>23.0
	6/24/2008	7.57	0.61	ND (<0.20)	510	98	ND (<0.50)	ND (<0.10)	0.048	89	0.2	>23.0
	9/22/2008	7.57	0.59	ND (<0.20)	430	54	ND (<0.50)	0.16	ND (<0.02)	74	0.2	6.9
M-16	11/8/2007	7.03	ND (<0.50)	2.1	810	160	ND (<0.50)	ND (<0.10)	0.34	60	0.07	>23.0
	3/19/2008	7.04	ND (<0.50)	ND (<0.20)	770	150	ND (<0.50)	0.66	0.18	49	ND (<0.05)	>23.0
	6/24/2008	7.01	ND (<0.50)	0.35	860	140	ND (<0.50)	ND (<0.10)	0.19	50	ND (<0.05)	>23.0
	9/22/2008	7.11	ND (<0.50)	.36	860	160	ND (<0.50)	6.8	0.31	60	ND (<0.05)	12
REGULATORY LIMITS												
Interim Groundwater Limits		6.5-8.5 (SMCL)	10 mg/l (MCL)	NA	450 mg/l	106 mg/l	See Notes (1)	0.3 mg/l (SMCL)	0.05 mg/l (SMCL)	69 mg/l	0.7 mg/l (Agricultural)	0 MPN/100 ml (MCL Goal)

Notes: ND = None detected at or above the laboratory reporting limit shown

mg/l = Milligrams per liter

µg/l = micrograms per liter

Bold type = Concentrations above referenced regulatory limits

NA = Not Applicable

MCL = Maximum Contaminant Level

SMCL = Secondary MCL

(1) = Trihalomethanes MCL's = Bromoform (4 µg/l), Bromodichloromethane (0.27 µg/l), Chloroform (1.1 µg/l), Dibromochloromethane (0.37 µg/l).



TABLE 3  
Concentrations of Analytes in Groundwater  
Quartz Reservoir  
Tuolumne Utilities District  
Wastewater Reclamation System

Monitoring Well #	Sample Date	pH	Nitrate as N	Total Kjeldahl Nitrogen	Total Dissolved Solids	Chloride	Total THMs	Iron	Manganese	Sodium	Boron	Total Coliform Organisms
M-1	1Q 2008	7.58	4.1	0.25	550	56	ND	ND	0.55	41	0.29	<1.1
	2Q 2008	7.44	2.4	ND	610	68	ND	0.074	0.62	44	0.23	<1.1
	3Q 2008	7.42	5.3	0.23	550	44	ND	0.077	0.38	40	0.22	<1.1
	4Q 2008	7.11	12	0.11	580	40	ND	0.27	0.46	46	0.27	<1.1
M-2	1Q 2008	8.38	0.088	ND	200	3.4	ND	0.15	0.16	7.5	0.58	<1.1
	2Q 2008	8.37	0.064	ND	210	4	ND	1	0.39	12	0.55	<1.1
	3Q 2008	8.35	0.045	0.12	250	4	ND	1.10	0.23	11	0.50	<1.1
	4Q 2008	7.72	0.22	ND	210	3.6	ND	0.33	0.17	6	0.56	<1.1
M-3	1Q 2008	7.38	ND	ND	480	22	ND	0.84	1.1	20	0.019	<1.1
	2Q 2008	7.12	ND	ND	480	27	ND	0.45	0.48	20	0.018	<1.1
	3Q 2008	7.08	ND	0.12	490	24	ND	0.42	0.39	19	0.011	<1.1
	4Q 2008	7.28	ND	ND	480	23	ND	0.32	0.6	21	0.013	<1.1
M-4	1Q 2008	9.15	ND	ND	230	1.3	ND	0.71	0.059	4.7	1.1	<1.1
	2Q 2008	9.11	ND	ND	220	1.3	ND	0.25	0.021	5.1	1.1	<1.1
	3Q 2008	9.23	ND	0.05	230	1.2	ND	0.18	0.024	4.4	0.88	<1.1
	4Q 2008	7.48	ND	0.049	250	1.4	ND	0.18	0.018	4.8	1.1	<1.1
M-5	1Q 2008	7.64	ND	ND	380	13	ND	0.097	0.34	14	0.22	<1.1
	2Q 2008	7.64	ND	ND	370	14	ND	0.17	0.37	15	0.026	<1.1
	3Q 2008	7.61	ND	0.1	360	13	ND	0.13	0.25	14	0.019	<1.1
	4Q 2008	6.97	ND	ND	370	12	ND	0.15	0.15	15	0.019	<1.1
REGULATORY LIMITS												
Interim Groundwater Limits		6.5-8.5 (SMCL)	10 mg/l (MCL)	NA	450 mg/l	106 mg/l	See Notes (1)	0.3 mg/l (SMCL)	0.05 mg/l (SMCL)	69 mg/l	0.7 mg/l (Agricultural)	<2.2 MPN/100 ml (MCL Goal)

Notes: Samples collected by and results compiled by TUD.

NA= Not Applicable

MCL = Maximum Contaminant Level

SMCL = Secondary MCL

(1) = Trihalomethanes MCL's = Bromoform (4 ug/l), Bromodichloromethane (0.27 ug/l), Chloroform (1.1 ug/l), Dibromochloromethane (0.37 ug/l).

58180400  
U.S.A.-B.L.M.

ROSASCO  
NORTHEASTERN  
STORAGE POND

250 L  
CONTAIN  
DITC  
30 LI  
CONTAIN  
DITC

ROSASCO  
BRANCH  
(T.U.D.)

5824013  
COMMERCIAL  
(VACANT)

582400100

ROSASCO DITCH  
WATER RES.

ROSASCO  
WESTERN  
STORAGE RES.

ROSASCO 103-ACRE  
APPLICATION AREA

ROSASCO EASTERN  
TAILWATER RETURN POND

COMMERCIAL  
5824011

AGRICULTURAL  
5824012

5824011

5823061

N. ROSASCO  
47 ACRES

5824006  
ROSASCO

5824007  
AGRICULTURAL

5823024

5823025

25

MONTEZUMA RD.

HWY. 100

582501200

# LEGEND

○ M-6 MONITORING WELL LOCATION

REFERENCE AVAILABLE FROM T.U.D.

APPROXIMATE SCALE IN FEET:  
1" = 600'  
0 600



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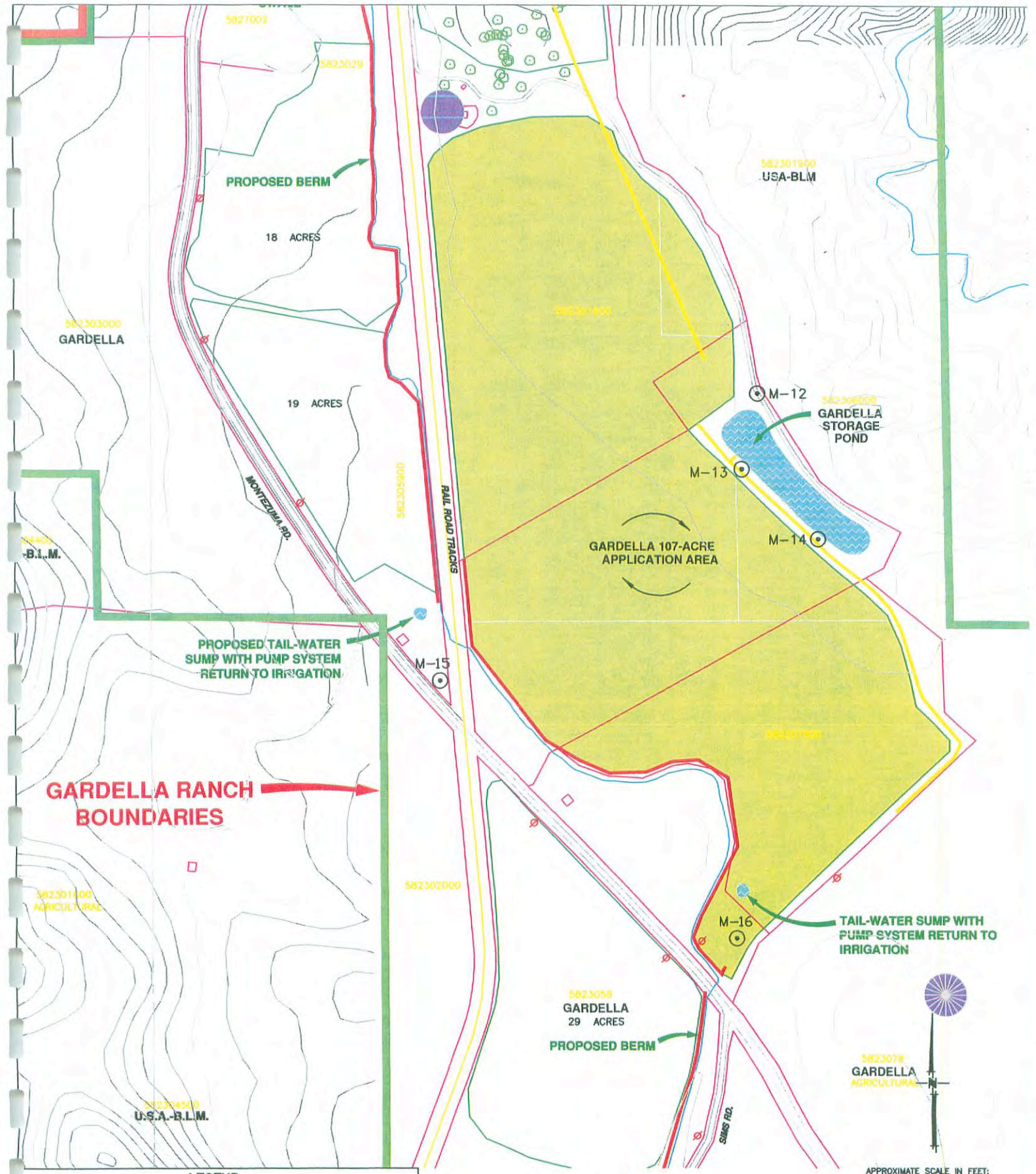
MONITORING WELL LOCATION MAP  
ROSASCO PROPERTY  
TUOLUMNE UTILITIES DISTRICT  
WASTEWATER RECLAMATION SYSTEM  
TUOLUMNE COUNTY, CALIFORNIA

PLATE

2A

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○ M-12    MONITORING WELL LOCATION  
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 FILE NAME: ST08D191.CAD

MONITORING WELL LOCATION MAP  
 GARDELLA PROPERTY  
 TUOLUMNE UTILITIES DISTRICT  
 WASTEWATER RECLAMATION SYSTEM  
 TUOLUMNE COUNTY, CALIFORNIA

PLATE  
 2B  
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581804800  
U.S.A.-B.L.M.

M-6  
(DRY)

ROSASCO  
NORTHEASTERN  
STORAGE POND

M-7  
(1326.78)

M-8  
(1319.96)

GROUNDWATER  
FLOW

ROSASCO 103-ACRE  
APPLICATION AREA

ROSASCO DITCH  
WATER RES.

M-9  
(DRY)

ROSASCO  
WESTERN  
STORAGE RES.

ROSASCO EASTERN  
TAILWATER RETURN POND

M-11  
(1274.35)

M-10  
(1277.44)

IRRIGATION WELL

ROSASCO  
DOMESTIC WELL

IRRIGATION WELL

N. ROSASCO  
47 ACRES

5824006  
ROSASCO

MONTEZUMA RD.

REFERENCE AVAILABLE FROM T.U.D.

#### LEGEND

○ M-6 MONITORING WELL LOCATION (1328.50) APPROXIMATE GROUNDWATER ELEVATION IN FEET

APPROXIMATE SCALE IN FEET:  
1" = 600'



DATE PRODUCED: 1/23/09  
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GROUNDWATER ELEVATION MAP (10/30/07)  
ROSASCO PROPERTY  
TUOLUMNE UTILITIES DISTRICT  
WASTEWATER RECLAMATION SYSTEM  
TUOLUMNE COUNTY, CALIFORNIA

PLATE

3A

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581804600  
U.S.A.-B.L.M.

ROSASCO DITCH  
WATER RES.

ROSASCO  
WESTERN  
STORAGE RES.

M-9  
(DRY)

ROSASCO 103-ACRE  
APPLICATION AREA

ROSASCO EASTERN  
TAILWATER RETURN POND

M-7  
(1330.38)

ROSASCO  
NORTHEASTERN  
STORAGE POND

M-8  
(1323.59)

M-11  
(1275.67)

M-10  
(1278.72)

IRRIGATION WELL

ROSASCO DOMESTIC WELL

IRRIGATION WELL

N. ROSASCO  
47 ACRES

ROSASCO

250 L  
CONTAIN  
DITCH  
30 LF  
CONTAIN  
DITCH

ROSASCO  
BRANCH  
(T.U.D.)

5824013  
COMMERCIAL  
(VACANT)

COMMERCIAL  
5824011

AGRICULTURAL  
5824012

5824014

5823005

MONTEZUMA RD.

5824006  
AGRICULTURAL

5823024

5823025

REFERENCE AVAILABLE FROM T.U.D.

# LEGEND

⊙ M-6 MONITORING WELL LOCATION

(1328.50) APPROXIMATE GROUNDWATER ELEVATION IN FEET

DATE PRODUCED: 1/23/09

PROJ. No.: 54975.E02

DRAWN BY: G. GOMEZ

CHECKED BY:

FILE NAME: ST09D009.CAD

GROUNDWATER ELEVATION MAP (3/18/08)  
ROSASCO PROPERTY  
TUOLUMNE UTILITIES DISTRICT  
WASTEWATER RECLAMATION SYSTEM  
TUOLUMNE COUNTY, CALIFORNIA

PLATE

3B

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SR1P04400  
U.S.A.-B.L.M.

M-6  
(DRY)

ROSASCO  
NORTHEASTERN  
STORAGE POND

M-7  
(1328.50)

250 L  
CONTAIN  
DITC  
30 LI  
CONTAIN  
DITC

M-8  
(1321.32)

ROSASCO  
BRANCH  
(T.U.D.)

ROSASCO DITCH  
WATER RES.

M-9  
(DRY)

ROSASCO 103-ACRE  
APPLICATION AREA

GROUNDWATER  
FLOW

ROSASCO  
WESTERN  
STORAGE RES.

ROSASCO EASTERN  
TAILWATER RETURN POND

M-11  
(1274.92)

M-10  
(1278.28)

IRRIGATION WELL

ROSASCO  
DOMESTIC WELL

IRRIGATION WELL

N. ROSASCO  
47 ACRES

ROSASCO

HWY. 100

MONTEZUMA RD.

REFERENCE AVAILABLE FROM T.U.D.

# LEGEND

⊙ M-6 MONITORING WELL LOCATION (1328.50) APPROXIMATE GROUNDWATER ELEVATION IN FEET

APPROXIMATE SCALE IN FEET:  
1" = 600'



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GROUNDWATER ELEVATION MAP (6/24/08)  
ROSASCO PROPERTY  
TUOLUMNE UTILITIES DISTRICT  
WASTEWATER RECLAMATION SYSTEM  
TUOLUMNE COUNTY, CALIFORNIA

PLATE

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581554600  
U.S.A.-B.L.M.

ROSASCO  
NORTHEASTERN  
STORAGE POND

M-6  
(DRY)

M-7  
(1326.74)

M-8  
(1319.81)

250 L  
CONTAIN  
DITC

30 LI  
CONTAIN  
DITC

ROSASCO DITCH  
WATER RES.

M-9  
(DRY)

ROSASCO 103-ACRE  
APPLICATION AREA

GROUNDWATER  
FLOW

ROSASCO  
BRANCH  
(T.U.D.)

582400100

5824013  
COMMERCIAL  
(VACANT)

ROSASCO  
WESTERN  
STORAGE RES.

ROSASCO EASTERN  
TAILWATER RETURN POND

M-11  
(1274.20)

M-10  
(1277.36)

IRRIGATION WELL

ROSASCO DOMESTIC WELL

IRRIGATION WELL

N. ROSASCO  
47 ACRES

5824006  
ROSASCO

5824007  
AGRICULTURAL

MONTEZUMA RD.

REFERENCE AVAILABLE FROM T.U.D.

# LEGEND

● M-6 MONITORING WELL LOCATION (1326.78) APPROXIMATE GROUNDWATER ELEVATION IN FEET

APPROXIMATE SCALE IN FEET:  
1" = 600'



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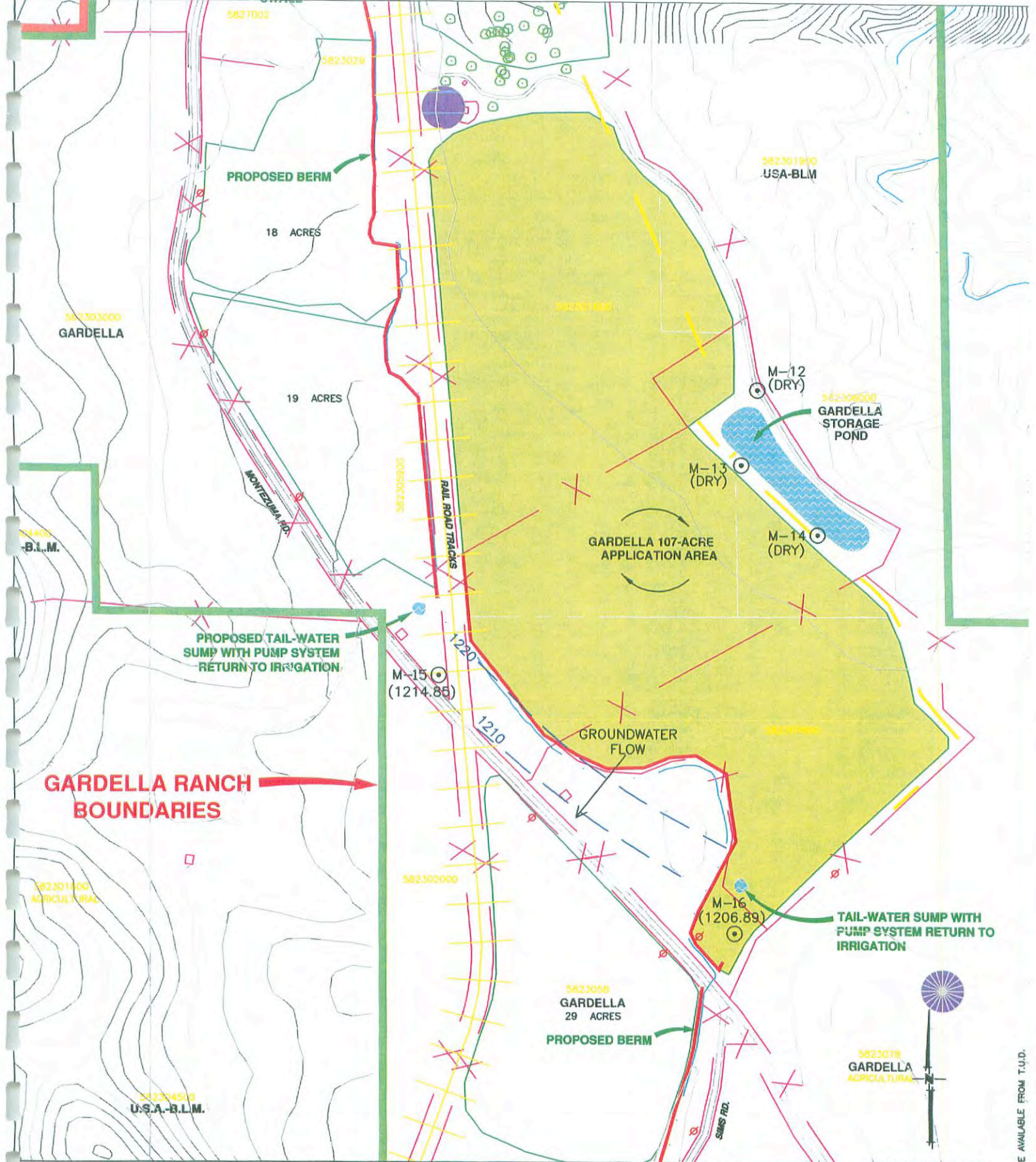
GROUNDWATER ELEVATION MAP (9/22/08)  
ROSASCO PROPERTY  
TUOLUMNE UTILITIES DISTRICT  
WASTEWATER RECLAMATION SYSTEM  
TUOLUMNE COUNTY, CALIFORNIA

PLATE

3D

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#### LEGEND

● M-12 MONITORING WELL LOCATION (1261.56) APPROXIMATE GROUNDWATER ELEVATION IN FEET

APPROXIMATE SCALE IN FEET:  
1" = 600'

REFERENCE AVAILABLE FROM T.U.D.



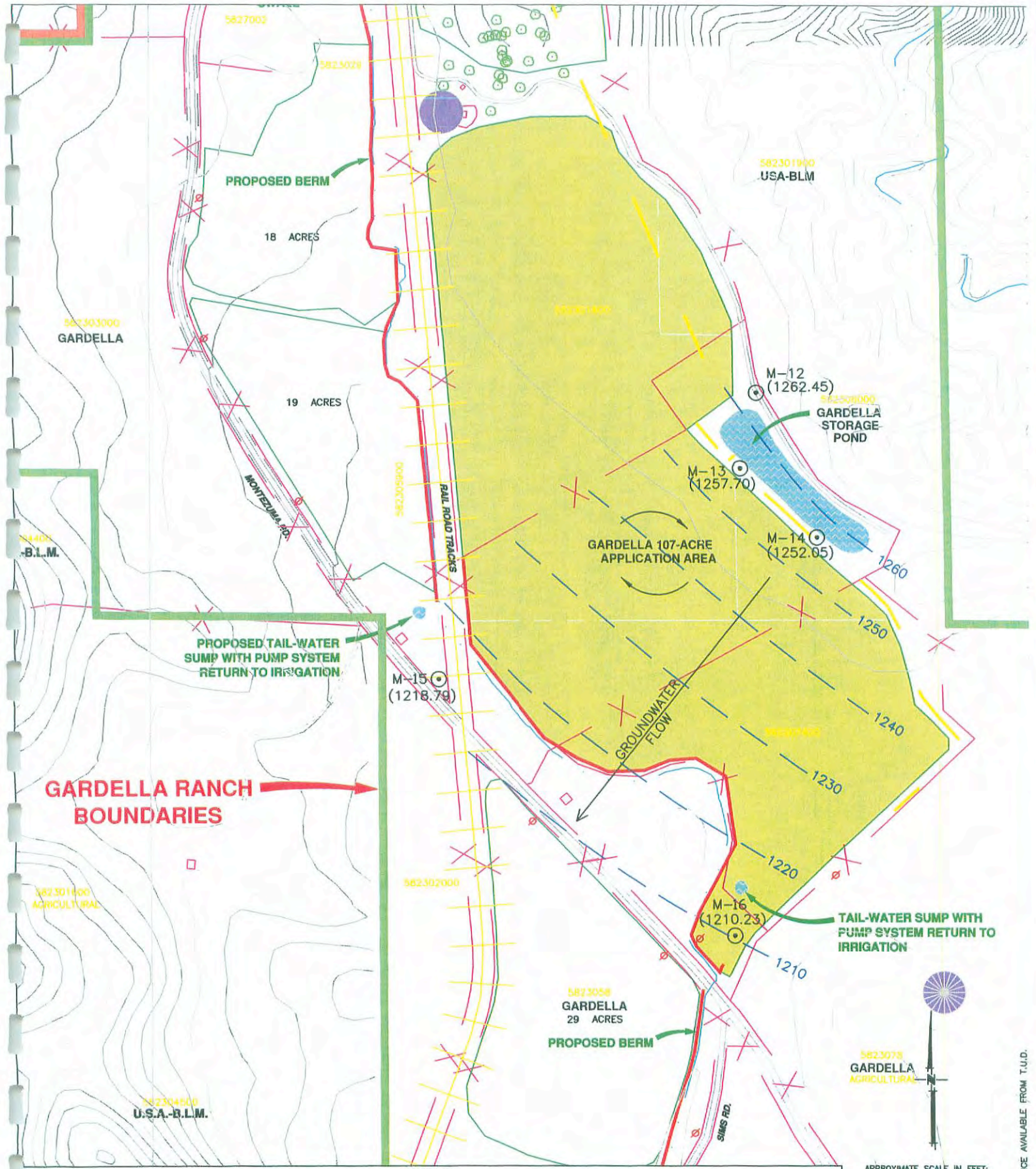
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GROUNDWATER ELEVATION MAP (11/8/07)  
GARDELLA PROPERTY  
TUOLUMNE UTILITIES DISTRICT  
WASTEWATER RECLAMATION SYSTEM  
TUOLUMNE COUNTY, CALIFORNIA

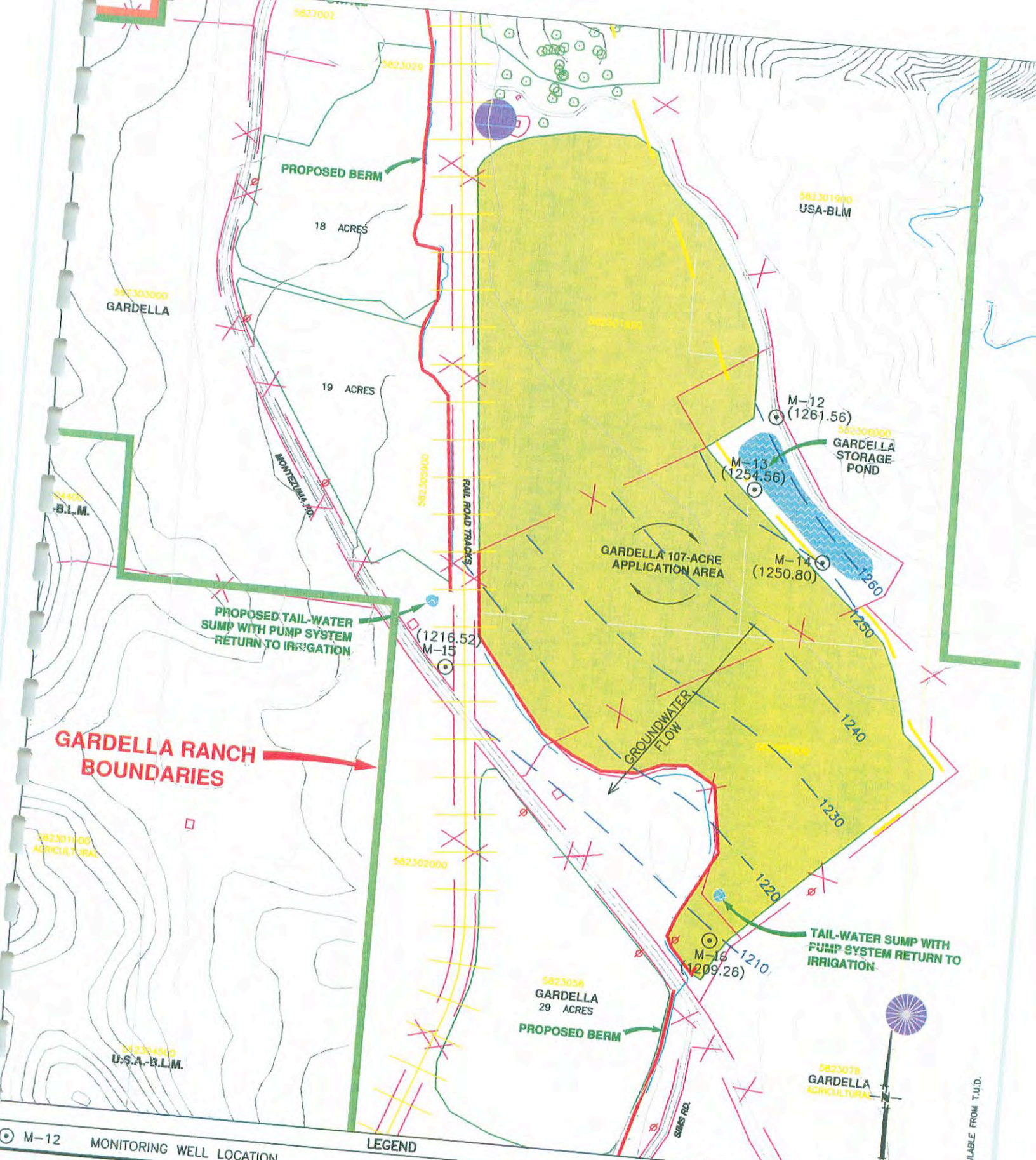
PLATE  
3E

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○ M-12 MONITORING WELL LOCATION

**LEGEND**

(1261.56) APPROXIMATE GROUNDWATER ELEVATION IN FEET

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GROUNDWATER ELEVATION MAP (6/24/08)  
GARDELLA PROPERTY  
TUOLUMNE UTILITIES DISTRICT  
WASTEWATER RECLAMATION SYSTEM  
TUOLUMNE COUNTY, CALIFORNIA

APPROXIMATE SCALE IN FEET:  
1" = 600'

PLATE

**3G**

REFERENCE AVAILABLE FROM T.U.D.



